Current Psychology (2026) 45:999
https://doi.org/10.1007/s12144-026-09567-8

How and when transformational leadership sparks innovative workplace behaviors: cumulative evidence from a meta-analytic review

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Received: 2 September 2024 / Accepted: 18 May 2026
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Abstract

Despite the growing body of research on innovative workplace behaviors (IWB)—a set of positive, change-oriented behaviors associated with transformational leadership (TL)—empirical findings remain mixed. While some studies report positive relationships, others report negative or nonsignificant results. To address these inconsistencies, this meta-analysis draws on Social Exchange and Self-Determination theories and adopts a multistage approach that clarifies when and how TL is associated with IWB by examining cultural contingencies (i.e., cultural configuration and uncertainty avoidance) through moderator analyses and testing psychological mechanisms (i.e., motivational, relational, and collaborative) using meta-analytic structural equation modeling (MASEM). A correlation-based meta-analysis (k = 174, N = 74,323) revealed a positive and significant overall effect for the TL-IWB relationship ($\hat{\rho}$ = 0.35, 95% CI [0.28,0.42]). Moderator analyses also showed that the overall effect size of the TL–IWB relationship was larger in studies conducted in vertical-collectivist cultures (e.g., Asian) ($\hat{\rho}$ = 0.41) and in cultures with high uncertainty avoidance ($\hat{\rho}$ = 0.45). Furthermore, MASEM results showed that trust in the leader, as a relational mechanism, fully mediated the TL–IWB link, whereas leader–member exchange (LMX) partially mediated it. Motivational mechanisms (psychological empowerment, work engagement, and intrinsic motivation) and collaborative mechanisms (psychological safety and knowledge sharing) partially mediated the link between TL and IWB. Collectively, these findings suggest that TL is associated with higher levels of IWB not only through culturally contingent leadership–follower dynamics but also through psychological, motivational, and relational pathways. Managerial implications, further research directions, and limitations are also provided.

Keywords Innovative workplace behaviors · Meta-analysis · Transformational leadership · Leadership

Introduction

Innovation is widely recognized as a critical driver of organizational performance, adaptability, and long-term sustainability (De Jong and Den Hartog 2010; Hughes et al. 2018).

At the individual level, innovative workplace behavior (IWB)—defined as the intentional generation, promotion, and implementation of novel and useful ideas—represents a key behavioral mechanism through which innovation materializes in organizations (De Jong and Den Hartog 2010). Unlike creativity, which primarily focuses on idea generation, IWB encompasses both idea generation and implementation (De Jong and Den Hartog 2010; Janssen 2000; Scott and Bruce 1994), making it a more comprehensive and action-oriented construct with direct organizational relevance.

Despite its importance, engaging in IWB is inherently risky for employees. Individuals who challenge the status quo may face resistance, increased workload, and social criticism (Bednall et al., 2018). As a result, employees are unlikely to engage in IWB unless supported by conducive

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Published online: 26 May 2026

leadership and contextual conditions (Janssen 2000; Scott and Bruce 1994). Among the various antecedents, transformational leadership (TL) has consistently been identified as one of the most influential drivers of IWB, as it inspires followers, fosters autonomy, and encourages change-oriented thinking (Lee et al. 2020; Zhu et al. 2023).

However, although a substantial body of research suggests a positive relationship between TL and IWB, empirical findings remain inconsistent. While many studies report strong positive effects (Kim et al. 2018; Liu et al. 2019), others reveal weak, non-significant, or even negative relationships (Basu and Green 1997; Miao et al. 2012; Ng et al. 2021). These inconsistencies suggest that the relationship between TL and IWB is neither universal nor direct, but rather contingent upon underlying mechanisms and contextual conditions. Yet, existing research has not fully explained how TL translates into IWB or when this relationship becomes stronger or weaker.

Prior meta-analyses have attempted to synthesize this literature, but important gaps remain. First, many studies (Lin et al. 2024; Koh et al. 2019; Zhu et al. 2023) conflate creativity with IWB, overlooking the critical distinction between idea generation and implementation. Second, prior syntheses (Agag et al. 2025; Bao et al. 2025) often focus on direct relationships or isolated mediators, without integrating multiple psychological mechanisms into a coherent framework. Third, existing research (Bao et al. 2025; Lee et al. 2020; Watts et al. 2020; Zhu et al. 2023) has largely neglected the simultaneous examination of mediating processes and contextual moderators, limiting our understanding of the boundary conditions under which TL is most effective.

To address these gaps, the present study develops a process-oriented and context-contingent framework to explain both how and when TL fosters IWB. Drawing on Social Exchange Theory (SET) (Blau 1964) and Self-Determination Theory (SDT) (Deci and Ryan 1985), we conceptualize TL as activating multiple, parallel psychological mechanisms that translate leadership into IWB. Specifically, we identify three clusters of mediating mechanisms: (1) motivational mechanisms (intrinsic motivation, psychological empowerment, and work engagement), (2) relational mechanisms (trust in leader and leader–member exchange), and (3) collaborative mechanisms (psychological safety and knowledge sharing). These mechanisms operate simultaneously, capturing the multifaceted pathways through which TL shapes employee IWB behavior.

In addition to these mechanisms, we argue that the effectiveness of TL is contingent upon cultural context. Building on configurational approaches to culture (e.g., Ng et al. 2011; Triandis & Gelfand, 1998; Singelis et al. 1995), we examine how vertical collectivism and uncertainty avoidance influence the strength of the TL–IWB relationship. In doing so, we extend prior research by integrating cultural boundary conditions into a unified explanatory framework.

We test our theoretical model using a comprehensive meta-analysis (k = 174, *N* = 74,323) combined with meta-analytic structural equation modeling (MASEM). This approach allows us to simultaneously estimate overall effect sizes, examine cultural moderators, and test multiple mediating pathways within a single analytical framework (Chen et al. 2022; Jak and Cheung 2020).

This study makes three key contributions to the literature. First, it provides a clearer, more precise estimate of the TL–IWB relationship by focusing exclusively on IWB, thereby avoiding conceptual conflation with creativity. Second, it advances theory by integrating multiple mediating mechanisms into a unified framework, offering a more comprehensive explanation of how TL translates into employee IWB. Third, it identifies important cultural boundary conditions, demonstrating when TL is effective across different societal contexts.

By integrating psychological mechanisms and cultural contingencies, this study moves beyond fragmented findings and offers a more coherent and theoretically grounded understanding of the TL–IWB relationship.

Theory and hypothesis development

This section examines the relationship between TL and IWB. Subsequently, we will explore potential moderators and test several mediators by using the MASEM approach (see Fig. 1).

Innovative workplace behaviors

IWB refers to a sequence of actions: identifying job-related problems, generating ideas or solutions, securing support for them, and implementing them within the organization (Scott and Bruce 1994). In essence, IWB involves creating or adopting new and useful ideas, processes, products, or procedures at the intra-organizational level (De Jong and Den Hartog 2007; Scott and Bruce 1994). The typical process starts with individuals seeking new ideas or best practices, followed by mobilizing others to adopt these ideas, and culminates in turning them into workable procedures for organization-wide use (Janssen 2000; Scott and Bruce 1994).

Research on IWB has grown substantially, and several systematic reviews have examined IWB and its theoretical correlates, drawing on leadership, motivation, organizational, and work-related theories (Farrukh et al. 2023) Sanlioz & Yildiz, 2026). Yet comprehensive syntheses of

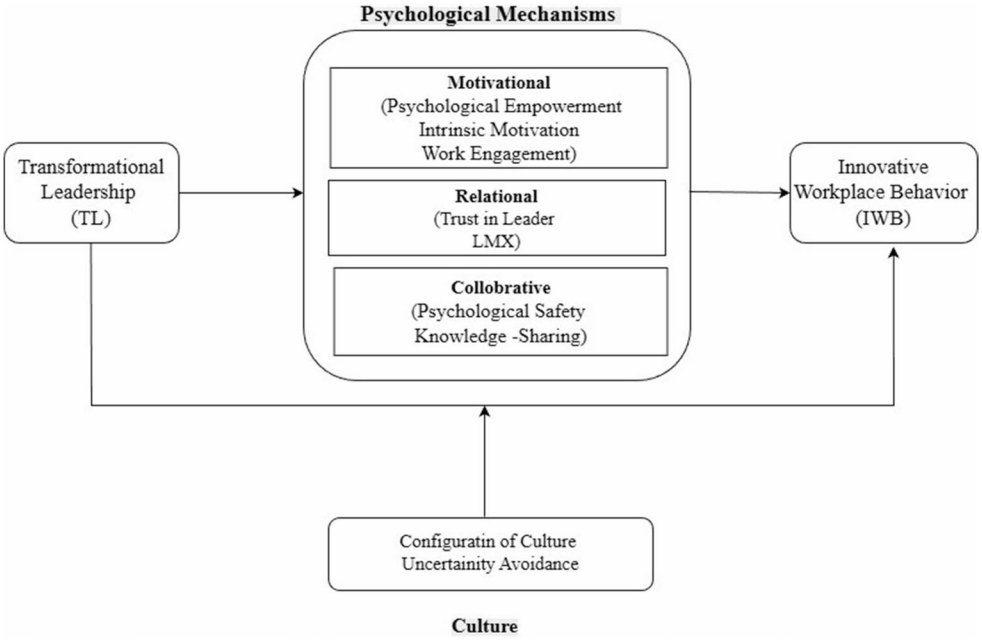


Fig. 1 The research model

cumulative findings remain limited (AlEssa and Durugbo 2022; Lee et al. 2020; Ng 2017; Watts et al. 2020; Yudiatmaja et al. 2023; Zhu et al. 2023). Some studies employ meta-analytic methods to examine the TL–IWB relationship (Agag 2025; Bao et al. 2025; Lee et al. 2020; Watts et al. 2020; Zhu et al. 2023), while others use bibliometric approaches to map the literature (AlEssa and Durugbo 2022; Yudiatmaja et al. 2023). Additionally, some studies treat IWB as a combination of creativity and innovation (Ng 2017) or explore TL–creativity pathways with mediating mechanisms (Koh et al. 2019; Zhu et al. 2023).

Creativity and innovation are interconnected yet separate constructs (Amabile 1988; Scott and Bruce 1994). Creativity is a cognitive endeavor that leads to new, useful, and original ideas. Innovation, on the other hand, is the process of generating, adopting, and implementing these ideas (Hughes et al. 2018; Kanter 1988; Van de Ven 1986; Yildiz et al. 2015). Building on this difference, creativity is about coming up with new ideas, while innovation is about starting and putting new ideas into action (Amabile 1988; King 2002; Lee et al. 2020; McLean 2005; Oman et al. 2013). Leadership is very important at all these stages because it affects how ideas come to be and how they are carried out. Supportive leadership fosters creative ideas by encouraging exploration and openness (Lee et al. 2020); however, transformational leadership is particularly important during the implementation phase. Transformational leaders help turn ideas into new behaviors at work that lead to positive changes in the organization by inspiring, motivating, and empowering their followers to act on their creative ideas.

Transformational leadership

TL involves inspiring followers to commit to a shared vision, challenging them to be innovative problem solvers, and developing leadership capacity through coaching and support (Bass and Riggio 2006). TL appeals to employees' moral values to raise awareness of ethical issues and mobilize reform (Yukl 2006) and has been shown to motivate followers to prioritize the collective good over personal interests (Seltzer et al., 1989). (Parry and Proctor-Thomson 2002) argue that transformational leaders (TLs) earn respect, admiration, and accountability from others, thereby enhancing followers' sense of empowerment.

Since its inception, TL has been widely regarded as a desirable and effective leadership style (Bass 1997). Bass's four-factor model is the most widely used conceptualization, defining TL through four components: idealized influence (charisma), inspirational motivation, intellectual stimulation, and individualized consideration (Bass and Avolio 1990). Idealized influence involves leaders' ability to affect followers emotionally and gain their respect; inspirational motivation articulates a compelling vision; intellectual stimulation encourages novel problem-solving and critical thinking; individualized consideration reflects caring for followers' well-being and treating them as individuals (Bass 1997; Bass and Avolio 1990).

Despite its multidimensional nature, many studies measure TL as a unidimensional construct due to measurement challenges (factorial distribution, cross-loadings, etc.) (Saboe et al. 2015). Accordingly, TL is treated as a unidimensional construct in this study.

The relationship between TL and IWB

Previous studies widely examined the TL-IWB relationship through the lenses of social cognitive theory (k = 8) (Bandura 1986) and social exchange theory (k = 7) (Blau 1964) (see Fig. 2). According to the principle of reciprocity, which underlies social exchange theory, the relationships between followers and leaders are shaped by both the leader's behaviors and the followers' perceptions towards the leader. Considering the components of TL, followers are therefore expected to be positively affected by transformational leaders' charisma, inspirational motivation, and intellectual stimulation, which together enhance enthusiasm and positive discretionary behaviors (Bass and Avolio 1990).

According to (Bass and Avolio 1990), TLs can intellectually stimulate their followers to critically reassess their work environment, uncover potential difficulties and ways of working from which creative ideas. Similarly, as noted above, TLs challenge followers to be innovative problem solvers (Bass and Riggio 2006). TLs recognize and value employee diversity; they tend to place importance on it, and such appreciation could provoke IWB (Akinci et al. 2022; Reuvers et al. 2008). Transformational leaders foster a sense of self-belief, confidence, and a compelling vision of the future among their followers, thereby motivating them to use novel and independent methods to complete their work.

As depicted in Scott and Bruce's (1994) IWB model, leaders play a pivotal role in revealing and promoting IWB. A leader's ability to build strong connections with followers, demonstrate remarkable qualities, empathize with them, and recognize them personally significantly influences the employees' tendency to engage in IWB. Since TL embodies many of these characteristics, it is expected to be positively associated with IWB. Accordingly, the first hypothesis is formulated as follows:

H1. The overall effect size of the TL-IWB relationship is positive.

Moderators

Given the significant heterogeneity observed in the overall effect size of the TL-IWB relationship across individual studies, contextual factors may shape the strength and direction of this link. Leadership and innovation are inherently linked to social and cultural contexts; therefore, the meaning and expression of transformational behaviors, as well as employees' readiness to engage in innovative actions, may differ across societies. Differences between Eastern and Western cultures in terms of power distance, collectivism, and attitudes toward uncertainty suggest that leaders' influence and followers' responses are not uniform across

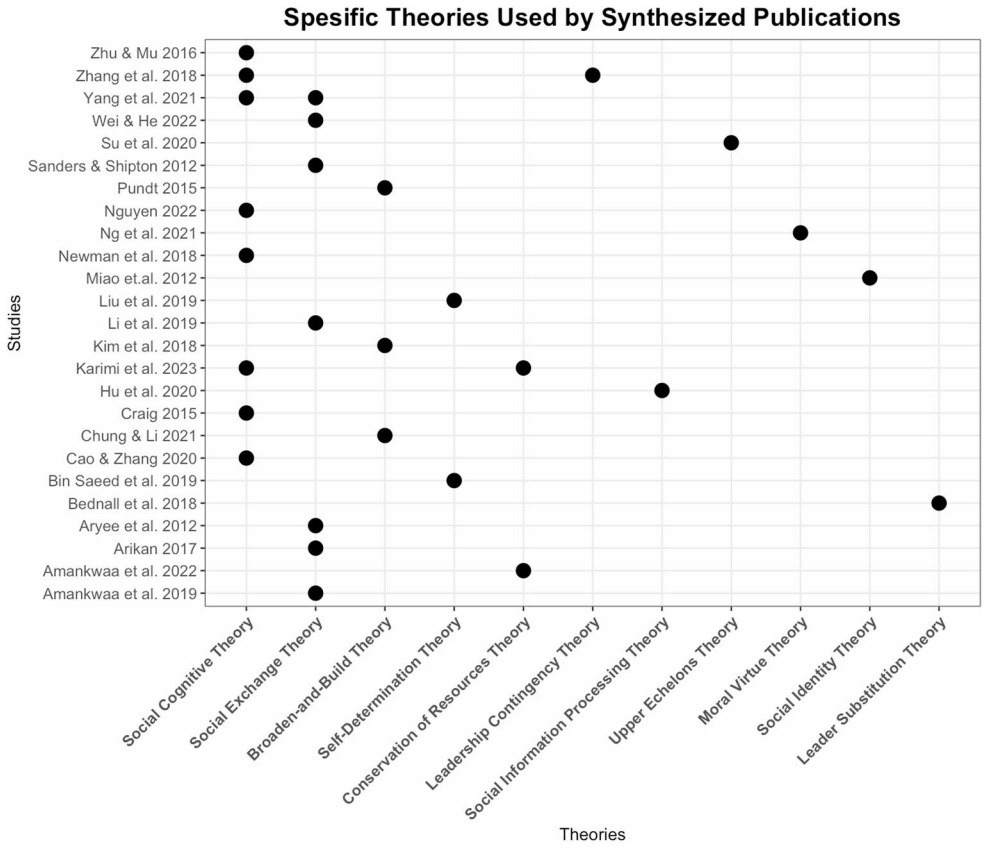


Fig. 2 Specific theories used for explaining TL-IWB relationship

settings (Hofstede 2001; House 2004). Consequently, cultural dimensions are examined as potential moderators to explain variability in the TL–IWB relationship across national contexts.

When TL sparks IWB: culture as the moderator

According to contingency leadership theory, the effectiveness of a single leadership style cannot be generalized globally, and a leader's effectiveness may vary across cultural contexts. Therefore, it is assumed that the effectiveness of transformational leadership in promoting IWB may be shaped by the national cultural contexts in which individual studies are conducted. Similarly, previous studies have stated that culture is an important boundary condition in determining the effectiveness of TL (Bao et al. 2025; Crede et al. 2019).

Building on this perspective, (Bass 1997) asserts that the effects of TL vary across cultures. In collectivistic cultures, leaders have a moral duty to look out for their followers, help them plan their professional development, attend their birthdays and funerals, and offer personal advice (Bass 1997). The same study found that subordinates might go above and beyond expectations, such as being dedicated and obedient, as a moral duty in response to the leader's actions. This suggests that the relational and moral underpinnings of TL may be more deeply aligned with cultures that prioritize harmony, duty, and interdependence. Despite this, much research on TL and IWB has been published in Eastern (collectivist) cultures (Craig 2015; Hansen & Pihl-Thingvad 2019; Pundt 2015) and in Western countries with individualist cultures (Aryee et al. 2012; Choi et al. 2016; Nguyen 2023). TL may be more prevalent in collectivistic cultures than in individualistic Western cultures (Jung et al. 1995).

Triandis (1995) defines individualism as "a social pattern that consists of loosely linked individuals who view themselves as independent of collectives; are primarily motivated by their own preferences, needs, rights, and the contracts they have established with others; give priority to their personal goals over the goals of others; and emphasize rational analyses of the advantages and disadvantages to associating with others" (p. 2). On the other hand, collectivism is defined as "a social pattern consisting of closely linked individuals who see themselves as parts of one or more collectives (family, co-workers, tribe, nation); are primarily motivated by the norms of, and duties imposed by, those collectives; are willing to give priority to the goals of these collectives over their own personal goals; and emphasize their connectedness to members of these collectives" (Triandis 1995 p. 2). In the context of TL, it implies that followers in collectivist cultures may be more inclined to adopt leaders' visions and participate in innovative behaviors that benefit the group. In individualist cultures, the connection between inspiration and behavior may be weaker because values emphasize autonomy.

Power distance is another important aspect of culture to consider. Power distance is defined as "the extent to which the less powerful members of institutions and organizations within a country expect and accept that power is distributed unequally" (Hofstede 1980) Given its dependence on respect, admiration, and moral authority, followers in high power-distance cultures may exhibit greater receptivity to the influence of such leaders, thereby demonstrating increased willingness to participate in discretionary innovation-related endeavors.

Hofstede's (1980) culture paradigm underpinned our use of national cultures as moderators. However, Hofstede's significant connections among national culture aspects (such as power distance and individualism-collectivism) raise concerns about multicollinearity (Fiss 2007; Hofstede 2001; Taras et al. 2010). Therefore, to address this situation, it has been determined that the configurational approach, which incorporates modifications to the two dimensions (power distance and collectivism-individualism), is more appropriate for cross-cultural research and leadership (Ng et al. 2011). This approach provides a more sophisticated comprehension of the relationship between hierarchical values (verticality) and collective orientations in influencing leader-follower dynamics.

Accordingly, (Triandis and Gelfand 1998) emphasized that both individualism and collectivism may be horizontal (emphasizing equality) or vertical (emphasizing hierarchy). Accordingly, it is stated that configuring individualism-collectivism and power distance cultural dimensions, such as horizontal individualism (low power distance-high individualism), horizontal collectivism (low power distance-high collectivism), vertical collectivism (high power distance-high collectivism), and finally vertical individualism (high power distance-high individualism), is more effective in explaining the effect of cultural factors on phenomena. In this context, TLs are expected to be most effective in vertical collectivist cultures, as these settings integrate respect for hierarchy with group loyalty—two cultural characteristics that closely correspond with TL's focus on vision, identification, and shared purpose.

When prior studies on culture are evaluated, they indicate that vertical collectivism is positively associated with innovative behavior (Nghia 2022). Also, some studies found that while horizontal individualism and collectivism are positively correlated with idea generation, vertical collectivism is positively associated with idea implementation (Yao et al. 2012). Similarly, (Zhang et al. 2022) found that employees with a high vertical collectivist orientation are

more creative than those with a high horizontal collectivist orientation. Taken together, these findings suggest that vertical collectivist contexts provide both social cohesion and hierarchical respect, enabling transformational leaders to mobilize followers toward innovation implementation rather than just idea creation.

In line with these studies, we coded the cultural dimensions into four different dimensions: horizontal individualism (HI), vertical individualism (VI), horizontal collectivism (HC), and vertical collectivism (VC) (Triandis and Gelfand 1998). In this context, the following hypothesis has been developed:

> *H2: The overall effect size of the TL-IWB relationship is larger in vertical collectivist cultures compared to other culture configurations.*

Another dimension of national culture linked to IWB is uncertainty avoidance (Afsar and Masood 2018; Agag 2025; Bao et al. 2025; Kim and Fan 2018; Watts et al. 2020). In addition to the previously mentioned social orientation of cultures (e.g., collectivism), how societies manage ambiguity and risk also influences the relationship between TL and innovation. This dimension, "uncertainty avoidance," shows how much people can handle ambiguity, regulations, and unpredictability. It also affects how likely employees are to try new things and do things in new ways.

Uncertainty avoidance is defined as "the extent to which the members of a culture feel threatened by uncertain or unknown situations" (Hofstede 2001: 161). The concept of innovation inherently requires going beyond borders and is closely related to uncertainty; countries' tolerance for uncertainty can vary (Afsar and Masood 2018; Hofstede 2001). In contrast to circumstances in which compliance with rules established by bureaucracies is obligatory, organizations operating in low-uncertainty-avoidance contexts possess greater autonomy and can prioritize social and innovative issues (Husted 2005). External forces expose organizations to coercive isomorphism and increase their adherence to regulations, standards, and bureaucracy in cultures with strong uncertainty avoidance (Eid and Agag 2020). This circumstance indirectly hinders organizational and individual creativity. In such cases, mimetic isomorphism is prioritized over creativity and innovation (Eid and Agag 2020). Therefore, according to this view, there may be greater potential for IWB in cultures with low uncertainty avoidance.

However, this relationship isn't completely straight. Low uncertainty avoidance promotes adaptability and risk-taking; however, it may also induce ambiguity and anxiety, which can obstruct coordination and achievement. Conversely, in environments where individuals dislike uncertainty and prioritize predictability and structure, TLs may fulfill a distinctive adaptive function by offering clarity, vision, and psychological safety.

On the other hand, when expectations are clear and unambiguous, people who are adept at avoiding uncertainty may exhibit different social attributions, greater cognitive ability to handle multiple ideas at once, and new ways of working (Park et al. 2007; Taras et al. 2010). It is proposed that employees may be more inclined to generate innovative ideas in cultures characterized by a dislike of uncertainty, influenced by the atmosphere and trust cultivated by team leaders with their followers (Afsar and Masood 2018; Watts et al. 2020). This happens because TLs help followers cope with change by reducing their anxiety, boosting their confidence, and making things feel more stable. This turns fear of the unknown into a source of new ideas for solving problems.

Stated differently, the provision of individualized attention and support by transformational leaders to their followers (Avolio and Bass 1995) may mitigate feelings of uncertainty and anxiety, thereby enabling employees to demonstrate their full potential through more innovative workplace behaviors (Ergeneli et al. 2007). Therefore, uncertainty avoidance not only performs as a boundary condition but also as a cultural context that enhances the positive impact of TL by transforming anxiety into trust-based engagement. It follows that:

> *H3: The overall effect size of the TL-IWB relationship is larger in cultures where uncertainty avoidance is high compared to cultures with low uncertainty avoidance.*

How TL sparks IWB: mediator roles of psychological mechanisms

One of the primary objectives of our study is to determine the overall effect size and direction of the TL-IWB relationship through a meta-analysis. Studies examining this relationship have observed variable results. Furthermore, various studies have demonstrated different mediating mechanisms linking TL and IWB. Another objective of our study is to elucidate the mechanisms by which TL's influence operates, particularly the psychological processes through which leaders translate innovative behaviors.

To facilitate our understanding of the relationship between TL and IWB from a theoretical perspective, we categorized the mediation processes into three distinct groups, each grounded in established theoretical frameworks (Social Exchange Theory and Self-Determination Theory) and conceptual frameworks (Blau 1964; Deci and Ryan 1985). This method involves creating an environment that facilitates the transition from individual inspiration (motivational) to relational interaction and, ultimately, to collective innovation.

This involves first emphasizing followers' intrinsic motivations, then building strong relationships with others, and finally fostering collaborative environments. This process demonstrates how TLs discover followers' intrinsic motivations, help them establish strong social connections, and then create environments where people can collaborate. This suggests that when examining the impact of leadership on IWB, these three psychological mechanisms play a pivotal role.

We first utilized Self-Determination Theory (Deci and Ryan 1985) to explain motivational mechanisms (intrinsic motivation, psychological empowerment, and work commitment). According to motivational mechanisms, competent leaders who allow their subordinates to take initiative by giving them sufficient latitude can increase innovation within the organization by increasing intrinsic motivation (Al Harbi et al. 2019). Also, leaders can encourage their followers to take the lead and generate new ideas by focusing on goals in their management processes. They do this by creating a sense of shared purpose and boosting their followers' confidence in their work. This is accomplished via intellectual stimulation and inspirational motivation (Moss and Ritossa 2007).

The second psychological mechanism, relational mechanisms (LMX and trust in the leader), has been explained using Social Exchange Theory (Blau 1964). Developing relationships based on mutual trust within an organization is a fundamental duty of a leader. Trust-based leadership behaviors ensure that employees are willing to take on tasks beyond their job descriptions and engage in creative, innovative activities for the organization's benefit. Relational mechanisms are incentives that emphasize the value of working with others, thereby turning employees' personal motivation into commitment to the organization. Followers believe they are making a valuable contribution to the leader and that there is a mutual exchange. These beliefs drive them to be innovative.

Collaborative mechanisms (psychological safety and knowledge sharing), as final psychological mechanisms, explain how TL creates a workplace where individuals can work safely and communicate easily to generate new ideas. By creating such environments, employees feel safe and accountable to their leaders for their knowledge-sharing activities. According to the SET (Blau 1964), TLs are in the role of making environments where people feel safe and can communicate to each other without any fear. This makes it easier for them to share information, grow, and put their ideas into action and come up with new ways of doing tasks. Consequently, collaboration becomes a form of mutual exchange in which followers feel supported, respected, and encouraged to pursue innovation beyond formal expectations.

This clustering approach is similar to the models and clustering used in other meta-analyses (Koh et al. 2019; Lee et al. 2020; Zhu et al. 2023), but it is a completely novel framework that focuses on the Tl-IWB. It allows us to model how multiple mediators are integrated into a unique framework, which explains how TL promotes IWB. Collectively, these mechanisms provide a process-oriented explanation: transformational leadership incentivizes employees to sustain continuous innovative performance. In doing so, it engages the individual (motivational), reciprocal (relational), and coordinating (collaborative) levels.

Motivational mechanisms

Meeting employees' needs for autonomy is crucial for maintaining employees' motivation in the workplace. According to Self-Determination Theory (SDT) (Deci and Ryan 1985), leaders motivate followers to work harder to achieve their goals by providing them with a vision that makes them feel more secure and self-confident (Jensen and Bro 2018). While doing so, TLs provide them with more psychological empowerment (Wei and He 2022). This theory argues that meeting basic psychological needs (autonomy, competence, and relatedness) is an important factor in employee engagement as, it increases intrinsic motivation. As a result, psychologically empowered employees place more emphasis on their tasks, function with a sense of autonomy, take initiative, and want to participate in decision-making, improve their environment, and IWBs at work (Garg et al. 2023; Liu et al. 2019). In this way, employees feel their work is more important, thereby increasing their intrinsic motivation (Kovjanic et al. 2012). Increased intrinsic motivation encourages employees to put out greater effort in their tasks and participate in IWB (Alshahrani 2025; Hon 2012; Tierney et al. 1999; Xu et al. 2023).

By establishing a vision, fostering trust, and granting employees autonomy, TL fosters psychological empowerment, intrinsic motivation, and work engagement. All these motivating factors work together to encourage employees, especially in uncertain environments, to take risks and engage in IWB. So, we suggest that;

> *H_4. The positive effect of TL on IWB is mediated by motivational mechanisms (psychological empowerment, intrinsic motivation, and work engagement).*

Relational mechanisms

Social Exchange Theory (Blau 1964; Homans 1961) claims that relationships between leaders and their followers are sustained through reciprocity and mutual obligation. When leaders demonstrate that they value and support their

followers as individuals, followers feel obligated to perform tasks that add value to the organization beyond those specified in their job descriptions, including IWB. According to (Choi et al. 2016), the theory posits that followers show their leaders appreciation by exhibiting positive behaviors and attitudes. These actions and attitudes include outstanding job performance, higher job satisfaction, and increased IWB (Choi et al. 2016). Social Exchange Theory (Blau 1964; Homans 1961) suggests that the relationships between leaders and followers are sustained through reciprocity and mutual obligation. When leaders show that they care about their followers as human beings and support them, followers feel obligated to do outstanding work, including IWB. The theory asserts that followers reciprocate their leaders' endeavors by exhibiting positive behaviors and attitudes, including work performance, job satisfaction, and IWB (Choi et al. 2016). SET (Blau 1964) posits that TLs foster a high-quality leader-member exchange (LMX) established by trust, support, and reciprocity (Tse et al. 2014; Wang et al. 2005). Leaders create a sense of safety and belonging by treating everyone fairly and with kindness, and by setting a good moral example. These relational environments boost followers' confidence and willingness to try something novel.

In other words, the charitable behaviors, attractiveness, and individualized interest of the leader cause a positive change in the emotions, behaviors, and beliefs of the followers, leading to the attachment of the employees to their leaders and creating an obligation to contribute to LMX (Howell and Shamir 2005; Shamir et al. 1993). Aligned with this theoretical perspective, LMX (Dansereau et al. 1975; Graen 1987; Graen and Uhl-Bien 1995) posits that the high-quality exchange relationship between leader and employee is a significant determinant of employee behavior (Gerstner and Day 1997). When employees trust their leaders, they are more inclined to express their ideas truthfully, exhibit initiative, and engage in innovative behavior in the workplace. (Schermuly et al. 2013). Drawing upon SET, we propose that;

H_5. The positive effect of TL on IWB is mediated by relational mechanisms (trust in leader and leader–member exchange).

Collaborative mechanisms

The final cluster, "collaborative mechanisms," encompasses the collective- and team-level dynamics by which TL promotes IWB, following the examination of motivational and relational mechanisms that elucidate individual and dyadic pathways from TL to IWB.

Knowledge sharing and psychological safety are key factors in the emergence of innovative behaviors and in their transformation from an individual dimension to a collective, actionable dimension (Lin 2007; Yin et al. 2020). The process by which the trust-based sharing of information between leaders and employees fosters a mutually beneficial environment in which employees feel safe is explained through the lens of Social Exchange Theory (Blau 1964). Consequently, followers develop a sense of reciprocity by engaging in activities that benefit the group, such as knowledge sharing and prosocial behavior.

To foster psychological safety, TLs create an environment where employees can express differing opinions and share their ideas without fear, regardless of the consequences (Carmeli et al. 2014). TLs also encourage employees to share the experiential knowledge and skills necessary to turn ideas into action (Lin 2007). TLs build up environments where individuals are provided with social resources that demonstrate trust and respect. Consequently, followers feel a sense of reciprocity by engaging in activities that benefit the group. These collaborative processes facilitate the distribution and implementation of innovative ideas collectively (Blomqvist and Levy 2006).

Establishing high-quality relationships with leaders enhances employees' psychological safety (Carmeli et al. 2014). In turn, they are more likely to go beyond their job descriptions in response to these positive relationships and to develop original and innovative solutions, ideas, and behaviors to problems and issues within the organization (Sharif et al. 2024). Moreover, research shows that the charisma attributed to TL is the most effective factor in knowledge-sharing behavior (Bryant 2003; Lam 2002). One important point in knowledge sharing is the heterogeneity and non-uniformity of knowledge collected within the organization (Huang and Liu 2015).

On the other hand, what is important in knowledge sharing is that the people who serve as the distribution centers of knowledge are truly knowledgeable (Kmieciak 2021). From a social exchange perspective (Blau 1964), TLs promote exchanges by acknowledging and rewarding employees who provide valuable knowledge, indicating that information sharing will be met with trust and support. At this point, it is critical for TLs to adopt encouraging and motivating approaches to heterogeneous knowledge sources so that shared knowledge translates into innovation (Huang and Liu 2015). Through this reciprocal exchange, followers consider knowledge sharing not solely as an individual endeavor but as a collaborative contribution to collective success. Therefore, knowledge sharing can create a collective organizational culture rather than an individual one and lead to IWB behaviors (Kim and Park 2017; Phung et al. 2019). Considering these arguments, we suggest that;

H_6. The positive effect of TL on IWB is mediated by collaborative mechanisms (psychological safety and knowledge sharing).

The research model illustrating the relationships among the study variables is presented in Fig. 1.

Method

Transparency and openness

The data analyzed in the current study, along with the table with detailed information about the included studies, their reference details, and the R codes used in the meta-analysis, are accessible at the following link: https://osf.io/b6wj5/overview?view_only=1f35984ec641422090bb47a59821bedb.

Article search and inclusion criteria

We initially searched for *"("innovative behavior" OR "innovative behaviour" OR "innovative workplace behavior" OR "innovative workplace behaviour") AND ("employee" OR "work" OR "workplace") AND ("transformational leadership")"* in the title, keyword, and abstract parts of databases such as PsycINFO, Web of Science, ABI/INFORM, EBSCO Host, SCOPUS, ResearchGate, ProQuest, PubMed, Google Scholar, and Yok Tez (Turkish Council of Higher Education Thesis Centre) to identify relevant articles. EndNote (v. 21) software was used as a reference management tool. Also, journal and conference publications related to management, psychology, and leadership were manually searched using the above-mentioned keywords. After determining potential mediators, we expanded the search to include mediators. Accordingly, the following search queries were searched: ("innovative behaviors" OR "innovative work behaviors") AND ("psychological empowerment"), ("innovative behaviors" OR "innovative work behaviors") AND ("psychological safety"), ("innovative behaviors" OR "innovative work behaviors") AND ("work engagement"), ("innovative behaviors" OR "innovative work behaviors") AND ("intrinsic motivation"), ("innovative behaviors" OR "innovative work behaviors") AND ("leader-member exchange" OR "LMX"), ("innovative behaviors" OR "innovative work behaviors") AND ("trust in leader" OR "leader trust" OR "trust in manager" OR "trust in leadership" OR "trust in supervisor"), ("transformational leadership") AND ("psychological empowerment"), ("transformational leadership") AND ("psychological safety")("transformational leadership") AND ("work engagement"), ("transformational leadership") AND ("intrinsic motivation"), ("transformational leadership") AND ("leader-member exchange" OR "LMX"), ("transformational leadership") AND ("trust in leader" OR "leader trust" OR "trust in manager" OR "trust in leadership" OR "trust in supervisor").

Following the initial search in October 2023 and the additional search for MASEM in July 2025, 174 publications were identified in relevant databases, published between 1996 and 2025. Of these publications, 38 primary empirical studies specifically examined the relationship between TL and IWB and met all inclusion criteria for the quantitative synthesis, as illustrated in Fig. 3.

As inclusion criteria, the relevant studies should have provided the correlation coefficient between TL–IWB, TL – mediators, and IWB – mediators; if they did not provide this information, they should have provided the statistics required to calculate the relevant effect size; they should be published in English and Turkish; and the samples of the studies should be employees. Since psychometric meta-analysis assumes that each effect size is derived from independent samples, if a study presents more than one effect size (e.g., (Bin Saeed et al. 2019), the average approach was used in studies presenting more than one effect size (Dahlke and Wiernik 2019).

The coding process was conducted by two authors. Firstly, a coding procedure was developed through collaboration among the authors. After creating the coding book, two coders coded the 174 eligible publications. The following information about the included studies was coded: author information, year, country, sample size, correlation coefficient of the TL-IWB relationship, theories used to explain the TL-IWB relationship, study type (grey/published), reliability coefficients (Cronbach's alpha coefficient) of TL and IWB, included mediator (yes/no), sector, research design (cross-sectional/longitudinal), outliers examination (yes/no), data collection method (in work/out of work), whether the data were collected during the COVID-19 period or not, whether control variables used (yes/no), gender dominance of sample (male dominant/female dominant), average age, culture scores of the countries, rating source of IWB (self-rated/supervisor rated), culture configuration (HI= Horizontal Individualism, VC=Vertical Collectivism, HC=Horizontal Collectivism, VI= Vertical Individualism). For the cultural scores of the countries, Hofstede's cultural comparison tool was used (The Culture Factor, n.d.). To determine whether a study is female- or male-dominated, the 50% threshold suggested by previous studies was used as the reference (Bae et al. 2014; Miao et al. 2018).

At the end of the coding process, intercoder reliability was evaluated using Cohen's Kappa to measure the agreement between two independent coders. The intercoder reliability was performed on 20% of the randomly chosen dataset. The mean Cohen's Kappa for all codes was 0.85, indicating almost perfect agreement (Cohen 1968, 1960;

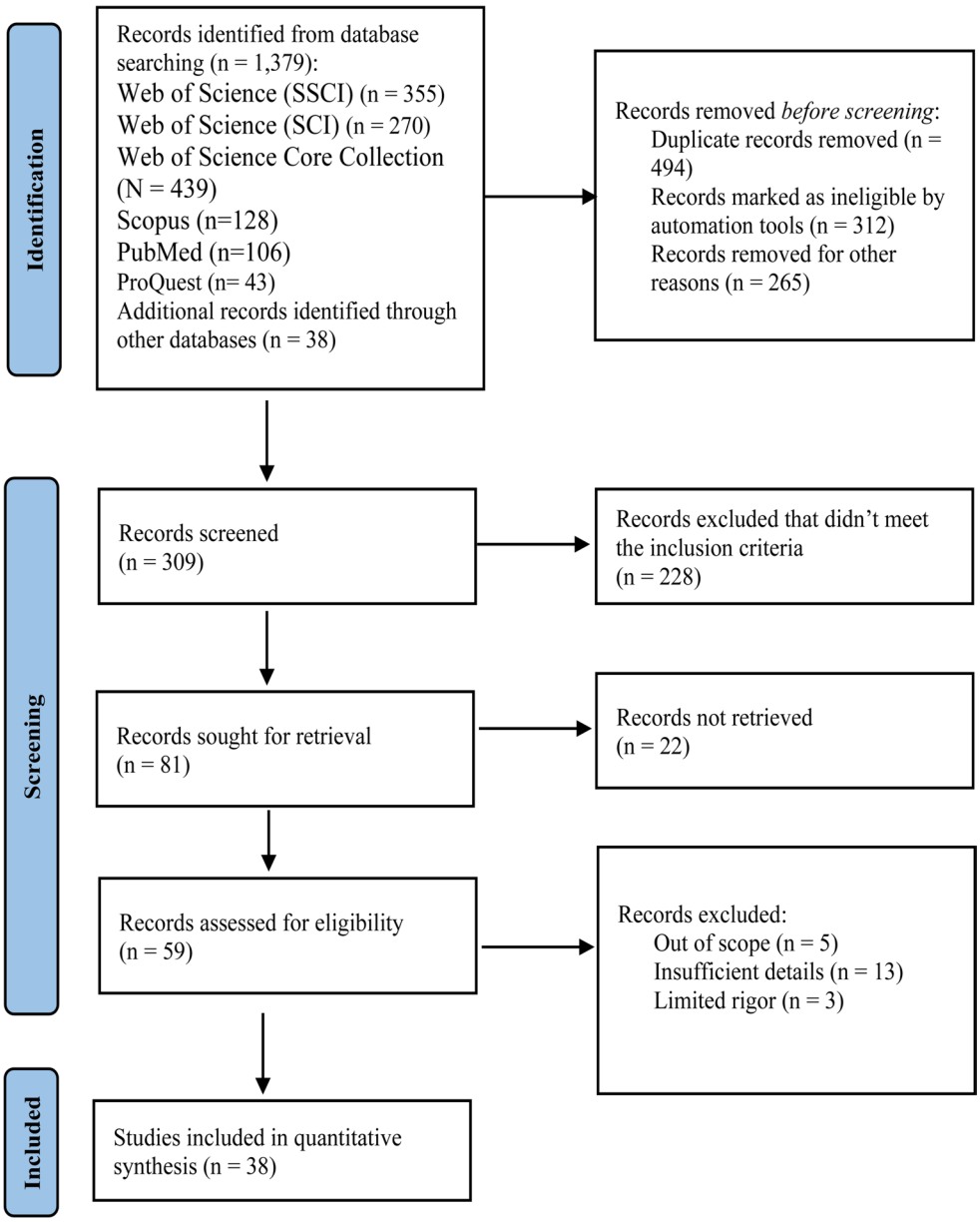


Fig. 3 PRISMA flow diagram

Landis and Koch 1977). Discrepancies were resolved via face-to-face consensus talks.

The results from all databases have been organized, and duplicate records have been screened out. We proceeded in this process using an Excel sheet and formulation. We then identified articles that we could automatically exclude from the title and abstract sections (e.g., meta-analyses, reviews, qualitative studies, languages other than those specified in the inclusion criteria, and studies whose samples included non-employees, such as students, CEOs, and managers). Then, the titles and abstracts were independently selected by two researchers in accordance with the inclusion criteria. First, we selected studies that conceptualized innovative workplace behaviors and related constructs. Thus, we excluded studies that focused only on creativity. Second, we requested correlation results by sending e-mails to the corresponding authors of the articles that did not report a correlation between IWB and TL. Following the identification and screening phases, 174 studies meeting the inclusion criteria were identified and included in the meta-analysis ($k = 174$, $N = 74{,}323$). The study related to TL and IWB was the primary focus of our original investigation; however, we broadened our search to include mediators identified throughout the evaluation. We employed the same sources as previously mentioned in our search method. This search procedure yielded the discovery of 136 additional studies. In all, we used 174 papers for the purpose of conducting a meta-analysis of the bivariate correlations and a MASEM analysis when examining the link between transformational leadership, IWB, and the mediators.

Meta-analytic procedure

Following Schmidt and Hunter's (2015) psychometric method, all analyses were conducted in R (R Core Team, 2024, version 4.4.2) by using the "psychmeta" (Dahlke and Wiernik 2019 v.2.7.0), "meta" (Balduzzi et al. 2019) v.8.0.2), "lavaan" (Rosseel 2012), "metaSEM" (Cheung 2015), and "metafor" package (Viechtbauer 2010 v.4.8.0).

The main reason to select the (Hunter 2004) methodology is that it employs a ran-om effects model, positing the possibility of more than one true population value among the included studies (Hunter 2004; Schmidt 2015). This approach typically involves correcting measurement errors by attenuating observed correlations and estimating the "true" population estimates. Also, the method usually also entails determining the "true" population estimates and attenuating observed correlations to address measurement errors (Pindek et al. 2024). Therefore, to avoid possible biases due to measurement errors and obtain unbiased results, reliability artifact correction was performed (Dahlke and Wiernik 2019; Wiernik and Dahlke 2020).

After selecting this approach, we computed the corrected effect sizes as follows. Initially, the overall effect size was computed based on 38 individual studies. To compute the overall effect size, we used the correlation coefficients between TL and IWB and the reliability coefficients for TL and IWB. To calculate corrected individual effect sizes for attenuation, reported correlations were divided by the square root of the TL and IWB's reliability coefficient. By following this step, we weight each corrected effect size by the study's sample size. Then, by using the corrected effect size and study weight, we computed the weighted mean corrected effect size for each study. Next, we computed the variance and corrected the sampling error. The sampling error variance is calculated by using the sample size and the corrected effect size. Firstly, average sampling error was computed. Next, using the variance of corrected effect sizes and the average sampling error variance, the observed variance in corrected correlations was computed. Finally, to correct for attenuation and measurement unreliability, we adjusted the observed correlations. We adjusted unreliability in the artifact distribution by using the weighted mean corrected effect size (r_{mean}) and the mean reliabilities of TL and IWB from the artifact distribution. The 95% CI was assessed as a reference for evaluating effect sizes (see Fig. 5). If the lower and upper limits do not include zero, the relevant effect size is statistically significant.

We used the conventional benchmarks given offered by (Cohen 1988) and subsequently modified by (Gignac and Szodorai 2016) to interpret the magnitude of the estimated effects. Although Cohen's (1988) classification was widely used to classify the calculated effect size as small (d = 0.2), medium (d = 0.5), and large (d = 0.8), these values were found to be too exigent (Bosco et al. 2015; Gignac and Szodorai 2016). Across 708 studies, (Gignac and Szodorai 2016) reported that 3% had an overall effect size of d = 0.50. Accordingly, after reviewing 708 meta-analyses, it was agreed that the effect size magnitude criteria should be 0.10, 0.20, and 0.30, corresponding to small, medium, and large effect sizes (Gignac and Szodorai 2016).

Before proceeding to moderator analysis, heterogeneity was assessed to determine the observed variability, a prerequisite for subgroup analyses. The I^2 value, the 80% probability interval (CR), and the standard deviation (SD) of the true score correlations were used to assess heterogeneity. The I^2value used in the assessment indicates the source of true heterogeneity, not sampling errors in the individual studies included (Borenstein 2011). (Higgins et al. 2003) classified theI^2 value as low (I^2 = 25%), moderate (I^2 = 50%), and high (I^2 = 75%). On the other hand, the credibility interval is assessed at 80% (Borenstein 2009). In this respect, while a wide range of CR indicates high-level heterogeneity (e.g., presence of potential moderators), a narrow CR indicates that the true effect size is consistent across studies (Whitener 1990). Finally, if the 80% CR includes zero, it means that the included studies have mixed results, indicating positive, negative, or nonsignificant effect sizes. Similarly, SDρ quantifies the variability between true effects in a collection of research and the observed effects in each individual study (Borenstein 2009). A higher SDρ indicates more variability in study effects. Similarly, according to (Borenstein 2009), SDρ measures the dissimilarity between the observed effects in a single study and the true effects across a set of studies. A higher level of variability occurs when the SDρ is larger.

We summarized the findings of the meta-analysis by reporting the number of studies included in the meta-analysis (k), total sample size across all studies (N), mean observed correlation ($\bar{r}$), observed standard deviation of r (SD_r), residual standard deviation of r (SD_{res}), mean true-score correlation ($\bar{\rho}$), observed standard deviation of corrected correlations (SD_{rc}); residual standard deviation of ρ ($SD\rho$), percent of variance in ($\bar{\rho}$ explained by statistical artifacts (Var_{art} %), confidence interval around $\bar{\rho}$ (95% CI), credibility interval around $\bar{\rho}$(80% CR), that show heterogeneity in the effect sizes (Sherf et al. 2024).

Given the significant variability observed across studies, moderator analysis was conducted to elucidate the sources of heterogeneity in the effect size. We assessed several indicators to detect proposed moderators. Firstly, an 80% corrected credibility interval (CR) was calculated to determine the presence of moderators. A wide range of CR interval means there may be potential moderators affecting heterogeneity in overall effect sizes (Whitener 1990). Secondly,

we deemed moderators to be present when the explained variance of statistical artifacts accounted for less than 75% of the variance in meta-analytic effect sizes (Schmidt 2015). Lastly, using the "psychmeta" package's ANOVA function—which does Wald-type pairwise comparisons—we investigated whether a given variable serves as a moderator (Serban et al. 2023; Whitener 1990).

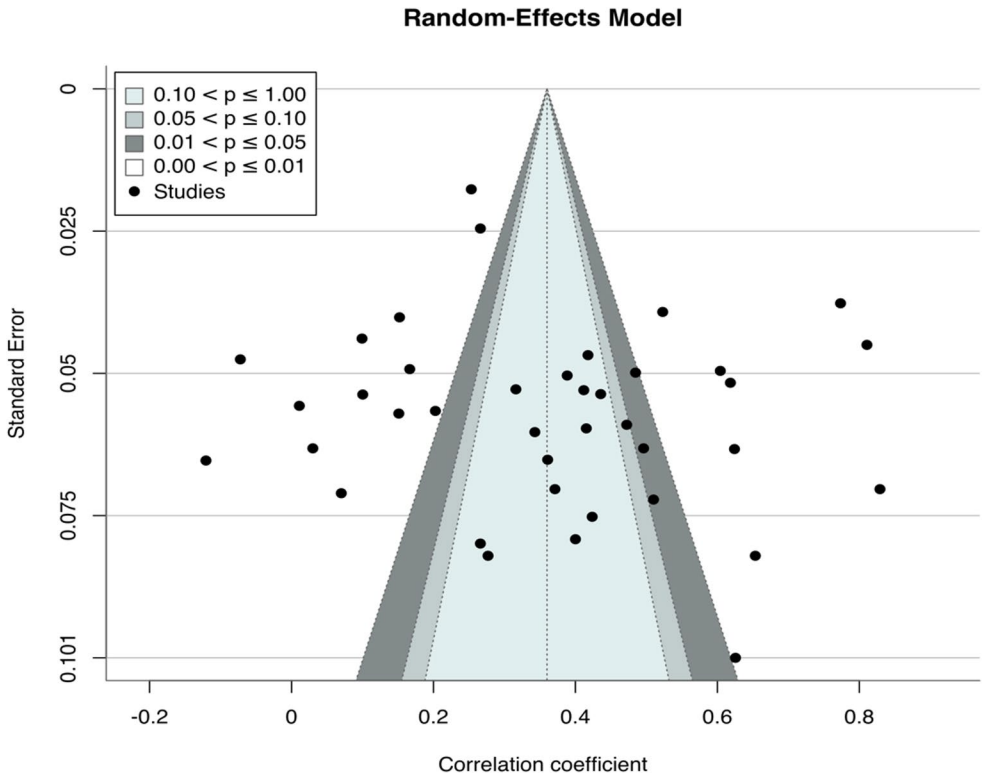
Mediation analysis was performed to investigate how TL influences IWB, while moderator analyses were used to explain when TL is more or less effective. We used a meta-analytic structural equation modeling (MASEM) technique to achieve this (Hoi & Schumacher, 2022). In the MASEM two-stage structural equation modeling (TSSEM) approach, as suggested by (Cheung 2015) and (Cheung and Chan 2005). Firstly, in the TSSEM 1 stage, pooled correlation matrices were created by drawing the relevant correlation coefficients from the primary research. For this study, the pairwise correlations (XY, XM, MY) extracted from the primary studies for each mediator relationship were coded into 7 separate Excel files, along with the relevant sample sizes. The aim of the TSSEM 1-stage is to obtain a general (pooled) correlation matrix by combining the correlation coefficients reported across independent studies using weighted averages. Also at this stage, correlations are combined using a random-effects model. Correlation matrices are calculated together with asymptotic covariance matrices. The results of this stage also include heterogeneity indices (e.g., Q and I^2). Before moving on to the TSSEM 2 stage, two matrices (Asymmetric and Symmetric) are created, namely the A (Structural Path Matrix) and the S (Residual/Covariance) matrix (Hoi and Schumacker 2022). Then, these matrices are used with the TSSEM1 output in the TSSEM 2-stage. Using the TSSEM 1-stage outputs (the covariance matrix created in the TSSEM1 stage), we tested the direct and indirect effects of the independent variables on the dependent variable, both directly and indirectly via mediators, in the TSSEM 2 stage. To fit mediation models, average correlation matrices were used. However, because the mediation models are saturated, we couldn't calculate the model fit indices (Kanadlı et al. 2023; Papadakis et al. 2024; Schutte et al. 2021).

Publication bias assessment

Publication bias is a frequent problem in meta-analytic studies and should be minimized to improve the accuracy of results (Rothstein 2005). In other words, it seeks to determine whether published studies are under representative of the total publication population, based on the assumption that the effect sizes of published publications are systematically differentiated from those of unpublished publications (Kepes et al. 2012). To mitigate the possibility of publication bias, we used multiple complementary methods.

First, as shown in Fig. 4, the distribution of the publications exhibits a symmetric pattern on both sides of the funnel plot. However, due to concerns regarding the reliability

Fig. 4 Funnel plot



of the Funnel plot in assessing publication bias (Sedgwick 2013; Sterne et al. 2011), additional analyses were conducted to strengthen the assessment.

Second, publication bias was assessed using the trim-and-fill method (Carter et al. 2019; Duval 2005). The analysis results revealed that no adjustments were necessary to correct the distribution, with an estimated zero number of missing studies on the left side.

Third, to further validate the robustness of the findings, additional statistical tests were conducted. Specifically, Egger's regression ($z = 0.690$, $p = .49$) and rank correlation tests ($\tau = 0.038$; $p = .73$) were performed (Begg and Mazumdar 1994; Egger et al. 1997).

Although restricting the analysis to English- and Turkish-language publications may increase the risk of language bias, such bias cannot be directly tested with statistical diagnostics. Instead, multiple publication bias assessments were conducted to examine whether the overall pattern of findings is sensitive to selective reporting or small-study effects. Collectively, the results of the funnel plot inspection, trim-and-fill procedure, Egger's regression, and rank correlation tests suggest that the findings are unlikely to be materially distorted by these biases. Nevertheless, as with all meta-analytic research, residual bias cannot be entirely ruled out and should be considered when interpreting the results.

Results

Direct relation

As shown in Fig. 5, the Fisher r-to-z converted correlation coefficient ranged from −0.12 to 0.83, with most estimates positive (95%). True outcomes have a 95% prediction interval of −0.08 to 0.82. Thus, although the average outcome is positive, some studies report negative results (Cao & Zang, 2020; (Ng et al. 2021).

Summarized in Table 2, the findings demonstrated a statistically significant positive relationship between transformational leadership (TL) and innovative workplace behaviors (IWB) ($\hat{\rho}$ = 0.35, 95% CI [0.28, 0.42]). Hence, Hypothesis 1 was supported, confirming that TL is positively associated with IWB.

The proportion of variance in mean true-score correlation ($\bar{\rho}$) explained by statistical artifacts (Var_{art}%) is 5.81%, which is far less than 75%, indicating the existence of

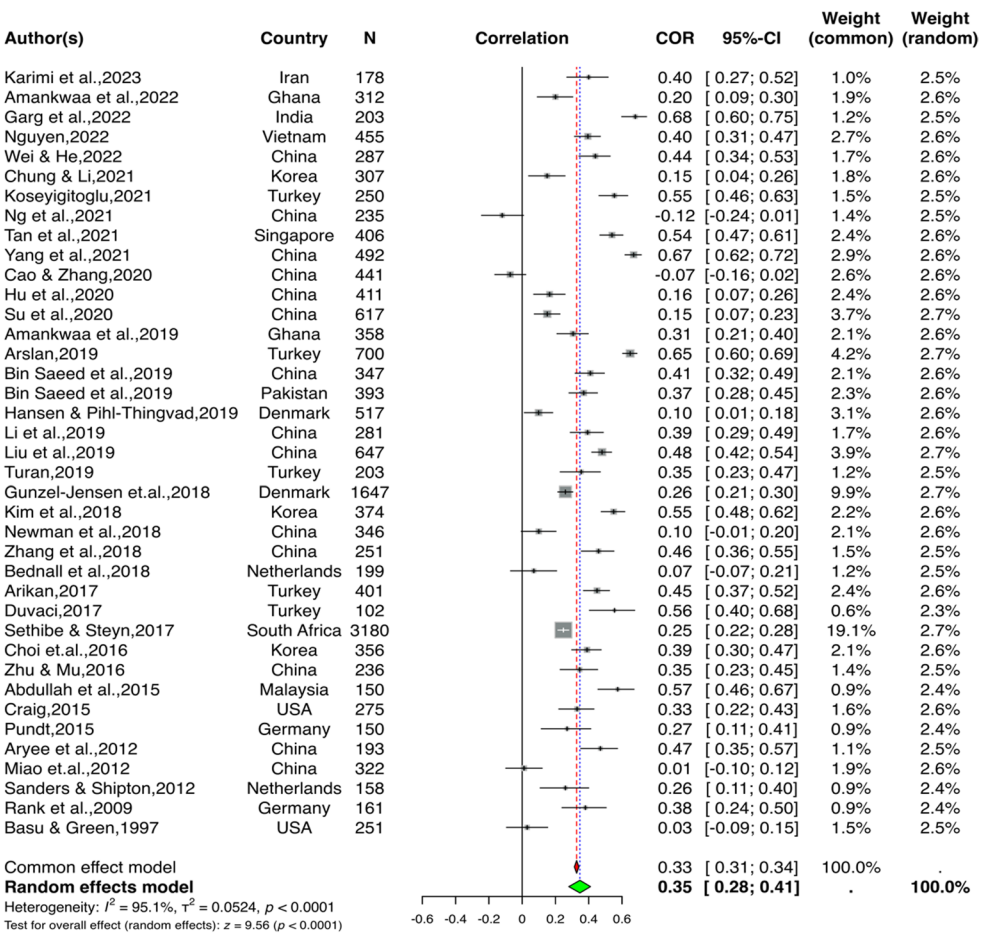


Fig. 5 Forest plot

potential moderators (Hunter 2004). Consistent with this interpretation, the I^2 value of 94% indicates substantial heterogeneity stemming from true heterogeneity rather than sampling error (Borenstein 2011; Higgins et al. 2003). We explored potential moderators to explain this variability. Consequently, moderator analyses were performed to investigate contextual factors that may explain this variation.

Power analysis

Power analysis was performed to test the statistical power of the meta-analysis (Valentine et al. 2010). For the calculation, the average sample size (N=431), summary effect size ($\widehat{\rho}$ =0.35), heterogeneity value (I^2), and number of effect sizes (k=38) recommended by previous studies were used (Winterton 2019). The power score for the meta-analysis, based on the 95% confidence interval, was 0.99 for the random-effects model (I^2=95.17%). To verify the robustness of the value obtained, the power was calculated to be 0.999 for the random-effects model (I^2=25%), even with an effect size of 0.10 and heterogeneity set to low, as suggested by (Winterton et al. 2020). Taken together, these findings suggest that the statistical power of the present meta-analyses is sufficient to detect significant effects in the TL–IWB relationship.

Moderators

Power analysis was performed to test the statistical power of the meta-analysis (Valentine et al. 2010). For the calculation, the average sample size (N=431), summary effect size ($\widehat{\rho}$ =0.35), heterogeneity value (I^2), and number of effect sizes (k=38) recommended by previous studies were used (Winterton 2019). The power score for the meta-analysis, based on the 95% confidence interval, was 0.99 for the random-effects model (I^2=95.17%). To verify the robustness of the value obtained, the power was calculated to be 0.999 for the random-effects model (I^2=25%), even with an effect size of 0.10 and heterogeneity set to low, as suggested by (Winterton et al. 2020). Taken together, these findings suggest that the statistical power of the present meta-analyses is robust and adequate to identify significant effects in the TL–IWB relationship.

Table 1 shows the results of the meta-analysis and moderator analyses.

Mediators

Before performing path analysis in the TSSEM 2-stage, the pooled correlations and significance levels for each mediator

Table 1 Meta-analytic results (artifact-distribution meta-analysis results)

Relationship	k	N	$\bar{r}$	SD_r	SD_{res}	$\bar{\rho}$	SD_{r_c}	SD_ρ	95% CI	80% CR	Var_{art}%	Sig. diff.
TL_eIWB (Overall effect)	38	16,423	0.31	0.19	0.18	0.35	0.21	0.20	[0.28, 0.42]	[0.08, 0.62]	5.81%	
Moderators												
1- Culture Configuration (Power distance- Collectivism vs. Individualism)												
a) Horizontal - Individualism	9	6 538	0.23	0.08	0.07	0.26	0.08	0.07	[0.20, 0.33]	[0.16, 0.36]	21.57%	b
b) Vertical - Collectivism	29	9 885	0.37	0.22	0.21	0.41	0.25	0.24	[0.32, 0.50]	[0.09, 0.72]	4.74%	a
2- Culture (Uncertainty avoidance) (F (1) = 4.25; p <.05)												
a) High	16	4 602	0.40	0.17	0.16	0.45	0.19	0.18	[0.35, 0.55]	[0.21, 0.69]	10.18%	b
b) Low	23	12 190	0.28	0.18	0.18	0.32	0.21	0.20	[0.23, 0.40]	[0.05, 0.58]	5.02%	a

TL Transformational Leadership, *IWB* Innovative Workplace Behaviours, k number of studies contributing to meta-analysis, N total sample size, $\bar{r}$ mean observed correlation, SD_r observed standard deviation of r, SD_{res} residual standard deviation of r, $\bar{\rho}$ mean true-score correlation, SD_{r_c} observed standard deviation of corrected correlations (r_c) , SD_ρ residual standard deviation of ρ , *CI* confidence interval around, *CR* credibility interval around percent of variance in explained by statistical artifacts, *Sig diff* significant difference. The characters in Sig.diff column correspond to those in the rows. They indicate whether effect sizes differ significantly at the 0.05 level. The sign "—" indicates a statistically insignificant difference between groups (i.e., non-significant moderator effect); Correlations corrected using artifact distributions

relationship were analyzed using the random-effects model in the TSSEM1 stage.

Firstly, three correlation values (X-M (path a), M-Y (path b), X-Y (path c)) for each mediator relationship were extracted from the primary studies and coded into a separate coding file. Since the mediator variables in the model were grouped into three psychological mechanisms, we divided mediator variables into motivational (psychological empowerment (PE), work engagement (WE), intrinsic motivation (IM)), relational (Leader-Member exchange (LMX), trust in leader (TRS)), and collaborative (knowledge sharing (KS), psychological safety (PS)) and the combined correlation analysis results for each mediator variable model were interpreted separately (see Table 2).

In this respect, when the pooled correlations among the transformational leadership (TL), proposed mediator (PE, PS, KS, LMX, WE, TRS, and IM), and innovative workplace behaviours (IWB) variables were evaluated, the meta-analytic results revealed the following findings:

As shown in Table 2, for the TL–PE–IWB relationship, TL was positively and significantly associated with PE (r =.47, 95% CI [0.38, 0.55], p <.001) and IWB (r =.35, 95% CI [0.29, 0.40], p <.001). Additionally, PE was also positively and significantly related to IWB (r =.49, 95% CI [0.42, 0.56], p <.001). The significance of all correlations Q statistics (Q (76) = 1330.43, p <.001), and high I^2 values for TL–PE (I^2 = 92.04%), TL–IWB (I^2 = 95.10%), and PE–IWB (I^2 = 95.55%) relationships indicate substantial heterogeneity. These findings demonstrate that a random-effects model is an appropriate framework for the TL–PE–IWB relationship.

When the TL–IM–IWB relationship is considered, TL showed a weak-to-moderate correlation with IM (r =.45, 95% CI [0.35, 0.55], p <.001) and a moderate association with IWB (r =.33, 95% CI [0.27, 0.39], p <.001). IM was also moderately associated with IWB (r =.39, 95% CI [0.29, 0.48], p <.001). The significance of all correlations (Q(61) = 1022.94, p <.001) and high I^2 values for the TL–IM (93.83%), TL–IWB (94.88%), and IM–IWB (93.95%) relationships indicate substantial heterogeneity. These findings demonstrate that the random effects model is an appropriate framework for the TL–IM–IWB relationship.

In the TL–WE–IWB relationship, TL was moderately associated with WE (r =.44, 95% CI [0.34, 0.54], p <.001) and with IWB (r =.32, 95% CI [0.26, 0.38], p <.001). Additionally, WE demonstrated a moderate-to-strong correlation with IWB (r =.44, 95% CI [0.38, 0.50], p <.001). The significance of all correlations (Q(66) = 976.26, p <.001) and high I^2 values for the TL–WE (92.87%), TL–IWB (94.24%), and WE–IWB (91.20%) relationships indicate substantial heterogeneity. These findings demonstrate that the random

Table 2 Stage one TSSEM- pooled correlations among the variables

Relations	k	*N*	Correlation	Mean *r*	95%CI	Z	*p*	I^2 (%)	Q
Motivational mechanisms									
TL-PE-IWB	11	3704	TL-PE	0.47	[0.38, 0.55]	11.23	<0.001	92	Q(76) = 1330,43 p <.001
	45	18,618	TL-IWB	0.35	[0.29, 0.40]	11.51	<0.001	95.1	
	23	9550	PE-IWB	0.49	[0.42, 0.56]	13.74	<0.001	95.6	
TL-WE-IWB	9	2695	TL-WE	0.44	[0.34, 0.54]	9.02	<0.001	92.8	Q(66) = 976.26,
	39	16,454	TL-IWB	0.32	[0.26, 0.38]	9.59	<0.001	94.2	p<.001
	21	7514	WE-IWB	0.44	[0.38, 0.50]	11.92	<0.001	91.2	
TL-IM-IWB	11	3099	TL-IM	0.45	[0.35, 0.55]	8.50	<0.001	93.8	Q(61) = 1022.94,
	40	17,028	TL-IWB	0.33	[0.27, 0.39]	10.44	<0.001	94.9	p<.001
	13	6369	IM-IWB	0.39	[0.29, 0.48]	13.95	<0.001	94	
Relational mechanisms									
TL-LMX-IWB	11	2631	TL-LMX	0.62	[0.49, 0.76]	22.46	<0.001	98.2	Q(64) = 1113.48,
	38	15,729	TL-IWB	0.33	[0.26, 0.40]	4.52	<0.001	95.2	p<.001
	18	6674	LMX-IWB	0.38	[0.32, 0.44]	8.21	<0.001	89	
TL-TRS-IWB	12	6186	TL-TRS	0.51	[0.41, 0.61]	10.04	<0.001	95.9	Q(57) = 978.23,
	41	17,631	TL-IWB	0.34	[0.29, 0.40]	11.93	<0.001	94.7	p<.001
	7	3654	TRS-IWB	0.48	[0.38, 0.58]	9.17	<0.001	93.2	
Collaborative mechanisms									
TL-KS-IWB	10	3957	TL-KS	0.41	[0.33, 0.49]	3.20	<0.001	88.9	Q(77) = 1276.63,
	43	17,636	TL-IWB	0.33	[0.28, 0.39]	10.66	<0.001	94.1	p<.001
	27	9244	KS-IWB	0.45	[0.38, 0.52]	10.55	<0.001	95.5	
TL-PS-IWB	7	7591	TL-PS	0.39	[0.23, 0.56]	4.80	<0.001	96.7	Q(53) = 958.51,
	38	16,351	TL-IWB	0.34	[0.28, 0.40]	11.01	<0.001	95.2	p<.001
	11	3432	PS-IWB	0.38	[0.27, 0.49]	6.83	<0.001	95.4	

TL Transformational leadership, *PE* Psychological empowerment, *KS* knowledge sharing, *LMX* Leader-Member Exchange, *TRS* Trust in Leader, *WE* Work Engagement, *IM* intrinsic motivation, *PS* Psychological Safety, *IWB* Innovative Workplace Behaviours

effects model is an appropriate framework for the TL–WE–IWB relationship.

As for the TL–TRS–IWB relationship, TL was positively and significantly associated with TRS (r =.51, 95% CI [0.41, 0.61], p <.001) and IWB (r =.34, 95% CI [0.29, 0.40], p <.001). Also, TRS was positively and significantly associated with IWB (r =.48, 95% CI [0.38, 0.58], p <.001). The significance of all correlations (Q (57)=978.23, p <.001) and high I^2 values for the TL–TRS (95.9%), TL–IWB (94.7%), and TRS–IWB (93.2%) relationships indicate substantial heterogeneity. These findings demonstrate that a random-effects model is an appropriate framework for the TL–TRS–IWB relationship.

In the TL–LMX–IWB relationship, TL was positively and significantly correlated with LMX (r =.62, 95% CI [0.49, 0.76], p <.001) and IWB (r =.33, 95% CI [0.26, 0.40], p <.001). Further, LMX was positively and significantly correlated with IWB (r =.38, 95% CI [0.32, 0.44], p <.001). The significance of all correlations (Q (64)=1113.48, p <.001) and high I^2 values for the TL–LMX (98.23%), TL–IWB (95.17%), and LMX–IWB (88.96%) relationships indicate substantial heterogeneity. These findings demonstrate that a random-effects model is an appropriate framework for the TL–LMX–IWB relationship.

For the TL–PS–IWB relationship, TL showed positive and significant correlation with PS (r =.39, 95% CI [0.23, 0.56], p <.001) and IWB (r =.34, 95% CI [0.28, 0.40], p <.001). Moreover, PS was positively and significantly associated with IWB (r =.38, 95% CI [0.27, 0.49], p <.001). The significance of all correlations (Q (53)=958.51, p <.001) and high I^2 values for the TL–PS (95.2%), TL–IWB (95.4%), and PS–IWB (95.4%) relationships indicate substantial heterogeneity. These findings demonstrate that a random-effects model is an appropriate framework for the TL–PS–IWB relationship.

Lastly, for the TL–KS–IWB relationship, TL was positively and significantly associated with KS (r =.41, 95% CI [0.33, 0.49], p <.001) and IWB (r =.33, 95% CI [0.28, 0.39], p <.001). Further, KS was positively and significantly associated with IWB (r =.45, 95% CI [0.38, 0.52], p <.001). The significance of all correlations (Q (77)=1276.63, p <.001) and high I^2 values for the TL–KS (88.9%), TL–IWB (94.1%), and KS–IWB (95.54%) relationships indicate substantial heterogeneity. These findings demonstrate that random effects-model is appropriate framework for the TL–KS–IWB relationship.

TSSEM1 analysis showed that all relations among TL, the mediators, and IWB, are positive and moderate. Similarly, significant heterogeneity was observed across all effect sizes. The Q and I^2 statistics for the correlation levels within each set of examined relationships suggest a high degree of heterogeneity across the examined relationships, while also demonstrating the need for an analytical approach that accounts for this variability. Based on the pooled correlations across the examined relationships and the robustness of the random-effects estimates, the next step was to test the hypothesized mediating mechanisms within a meta-analytic structural equation modeling framework (TSSEM Stage 2).

The TSSEM2 stage was conducted to assess how these relationships operate concurrently within a meta-analytic structural equation framework (MASEM), given the aggregated correlations and the significant heterogeneity observed across studies. This step incorporates the pooled effect sizes into a single path model, allowing a direct test of the proposed mediation mechanisms (see Fig. 3).

Mediator effects were analyzed using path analysis in the TSSEM2 stage (see Table 3). According to the MASEM model, in transformational leadership (TL) – psychological empowerment (PE) – innovative work behavior (IWB) relationship, the effect of TL on PE (β=0.47, 95% CI [0.38, 0.55]) and the effect of PE on IWB are significant (β=0.42, 95% CI [0.33, 0.52]). The direct (β=0.15, 95% CI [0.05, 0.24]) and indirect (β=0.20, 95% CI [0.14, 0.26]) effect of TL on IWB are statistically significant, with a notably stronger indirect path through PE, suggesting partial mediation. Further, TL explains 26% of the variance in IWB through PE.

In the transformational leadership (TL) – work engagement (WE) – innovative work behavior (IWB) relationship, the effect of TL on WE (β=0.44, 95% CI [0.34, 0.54]) and the effect of WE on IWB are significant (β=0.37, 95% CI [0.28, 0.45]). The direct (β=0.16, 95% CI [0.07, 0.25]) and indirect effect (β=0.16, 95% CI [0.12, 0.22]) of TL on IWB are significant, indicating that WE serve as a partial mediator. Further, TL explains 21% of the variance in IWB through WE.

As for the transformational leadership (TL) – intrinsic motivation (IM) – innovative work behavior (IWB**)** relationship, the effect of TL on IM (β=0.45, 95% CI [0.35, 0.55]) and the effect of IM on IWB are significant (β=0.30, 95% CI [0.18, 0.42]). The direct (β=0.20, 95% CI [0.10, 0.30]) and indirect effect (β=0.14, 95% CI [0.08, 0.20]) of TL on IWB are significant, indicating that IM serves as a partial mediator. Further, TL explains 18% of the variance in IWB through IM. Thus, Hypothesis 4 was supported.

In the transformational leadership (TL) – leader–member exchange (LMX) – innovative work behavior (IWB) relationship, the effect of TL on LMX (β=0.63, 95% CI [0.49, 0.76]) and the effect of LMX on IWB are significant (β=0.29, 95% CI [0.17, 0.42]). The direct (β=0.15, 95% CI [0.11, 0.16]) and indirect effect (β=0.18, 95% CI [0.10, 0.30]) of TL on IWB were statistically significant, indicating that LMX serves as a partial mediator. Further, TL explains 16% of the variance in IWB through LMX.

Table 3 Stage two TSSEM- path analysis

Path	Estimate(β)	95% CI	Explained variance (%)	Effect Type	Decision
Motivational mechanisms					
Mediator role of psychological empowerment (PE)					
TL → PE	0.47	[0.38, 0.55]	22%	Direct	Partial
PE → IWB	0.42	[0.33, 0.52]	-	Direct	
TL → IWB	0.15	[0.05, 0.24]	-	Direct	
TL → PE → IWB	0.20	[0.14, 0.26]	26%	Indirect	
Total (TL → IWB)	0.35			Total Effect	
Mediator role of work engagement (WE)					
TL → WE	0.44	[0.34, 0.54]	19%	Direct	Partial
WE → IWB	0.37	[0.28, 0.45]	-	Direct	
TL → IWB	0.16	[0.07, 0.25]	-	Direct	
TL → WE → IWB	0.16	[0.12, 0.22]	21%	Indirect	
Total (TL → IWB)	0.32			Total Effect	
Mediator role of intrinsic motivation (IM)					
TL → IM	0.45	[0.35, 0.55]	20%	Direct	Partial
IM → IWB	0.30	[0.18, 0.42]	-	Direct	
TL → IWB	0.20	[0.10, 0.30]	-	Direct	
TL → IM → IWB	0.14	[0.08, 0.20]	18%	Indirect	
Total (TL → IWB)	0.34			Total Effect	
Relational mechanisms					
Mediator role of Leader-Member exchange (LMX)					
TL → LMX	0.63	[0.49, 0.76]	%39	Direct	Partial
LMX → IWB	0.29	[0.17, 0.42]	-	Direct	
TL → IWB	0.15	[0.11, 0.16]	-	Direct	
TL → LMX →IWB	0.18	[0.10, 0.30]	%16	Indirect	
Total (TL → IWB)	0.33			Total Effect	
Mediator role of trust in leader (TRS)					
TL → TRS	0.51	[0.41, 0.62]	%26	Direct	
TRS → IWB	0.41	[0.27, 0.56]	-	Direct	Full
TL → IWB	0.13	[0.00, 0.24]	-	Direct	
TL → TRS → IWB	0.21	[0.13, 0.32]	%24	Indirect	
Total (TL → IWB)	0.34			Total Effect	
Collaborative mechanisms					
Mediator role of knowledge sharing (KS)					
TL → KS	0.41	[0.33, 0.49]	%16	Direct	Partial
KS → IWB	0.38	[0.28, 0.47]	-	Direct	
TL → IWB	0.18	[0.10, 0.26]	-	Direct	
TL → KS → IWB	0.15	[0.11, 0.21]	%23	Indirect	
Total (TL → IWB)	0.33			Total Effect	
Mediator role of psychological safety (PS)					
TL → PS	0.39	[0.23, 0.56]	%16	Direct	Partial
PS → IWB	0.29	[0.15, 0.42]	-	Direct	
TL → IWB	0.23	[0.12, 0.32]	-	Direct	
TL → PS → IWB	0.11	[0.06, 0.20]	%19	Indirect	
Total (TL → IWB)	0.34			Total Effect	

TL Transformational leadership, *PE* Psychological empowerment, *KS* knowledge sharing, *LMX* Leader-Member Exchange, *TRS* Trust in Leader, *WE* Work Engagement, *IM* intrinsic motivation, *PS* Psychological Safety, *IWB* Innovative Workplace Behaviours

In the transformational leadership (TL) – trust in leader (TRS) – innovative work behavior (IWB) relationship, the effect of TL on TRS (β=0.51, 95% CI [0.41, 0.62]) and the effect of TRS on IWB are significant (β=0.41, 95% CI [0.27, 0.56]). The direct effect of TL on IWB was weak and nonsignificant (β=0.13, 95% CI [0.00, 0.24]), whereas the indirect effect (β=0.21, 95% CI [0.13, 0.32]) was significant, indicating that TRS fully mediates the relationship. Further, TL explains 24% of the variance in IWB through TRS. Accordingly, Hypothesis 5 was supported.

Lastly, in the transformational leadership (TL) – knowledge sharing (KS) – innovative work behavior (IWB) relationship, the effect of TL on KS (β=0.41, 95% CI [0.33, 0.49]) and the effect of KS on IWB are significant (β=0.38, 95% CI [0.28, 0.47]). The direct (β=0.18, 95% CI [0.10, 0.26]) and indirect effect (β=0.15, 95% CI [0.11, 0.21]) of TL on IWB are significant, indicating that KS serves as a partial mediator. Further, TL explains 23% of the variance in IWB through KS.

In the transformational leadership (TL) – psychological safety (PS) – innovative work behavior (IWB) relationship, the effect of TL on PS (β=0.39, 95% CI [0.23, 0.56]) and the effect of PS on IWB are significant (β=0.29, 95% CI [0.15, 0.42]). The direct (β=0.23, 95% CI [0.12, 0.32]) and indirect effect (β=0.11, 95% CI [0.06, 0.20]) of TL on IWB are significant, indicating that PS serves as a partial mediator. Further, TL explains 19% of the variance in IWB through PS. Accordingly, Hypothesis 6 was supported.

Discussion

The main motivation of this study is to clarify the inconsistencies or mixed results between TL and IWB in the context of culture, to identify potential mediating mechanisms that have a carrier role in the emergence of IWB, which is a reflection of the implementation phase of the innovation process, and to determine in which contextual and mediating mechanisms TL is more effective. Grounded in Self-Determination Theory (Deci and Ryan 1985) and Social Exchange Theory (Blau 1964), we examined how TL influences IWB through three psychological mechanisms: motivational, relational, and collaborative, using meta-analytic structural equation modeling (MASEM). Additionally, we investigated how the strength of the TL-IWB relationship changes when contextual factors, such as cultural configuration and uncertainty avoidance, act as moderators.

When all findings are evaluated, critical motivational, relational, and collaborative psychological mechanisms (mediator) and cultural boundaries (moderator) shaping the TL–IWB relationship have been identified. Specifically, all bivariate relationships between TL, the mediator variables, and IWB are statistically significant and positive. When the MASEM results examining the mediator relationships are evaluated, it is clear that the TL–IWB relationship is a complex issue that must be addressed in light of the mediator variables. Researchers are recommended to pay special attention to the trust in the leader variable in the TL–IWB relationship. On the other hand, studies conducted in vertical collectivist cultures and cultural environments with high uncertainty avoidance have found the TL–IWB relationship to be stronger. The findings also suggest that several mediating variables were not analyzed because they were underrepresented in primary studies, thereby offering avenues for future research.

These results form the basis of several key contributions to the literature. First, unlike previous studies that grouped creativity (idea generation) and innovative behavior (idea implementation) under the broad umbrella of IWB (Gui et al. 2020; Ng 2017; Watts et al. 2020), we focused exclusively on IWB by excluding studies that focused on creativity rather than IWB. This distinction differentiates our study from earlier work by emphasizing the implementation-oriented nature of IWB and sharpening our conceptual boundaries. Second, previous meta-analyses synthesized only consistent positive findings regarding the TL-IWB relationship (Gui et al. 2020; Lee et al. 2020; Ng 2017; Watts et al. 2020), without including studies reporting unexpected results (e.g., negative or non-significant). This study seeks to clarify this ambiguity and provide a more complete understanding of the TL-IWB relationship by incorporating deviations from it. Furthermore, contextual moderators such as uncertainty avoidance and culture configuration, which were largely overlooked in previous studies, were examined to identify when TL exerts a stronger or weaker influence on IWB. These contributions offer useful guidance for future studies seeking to generate more accurate and context-sensitive estimates. Finally, to provide a more comprehensive understanding of the mechanisms underlying the TL-IWB link, we presented cumulative evidence on how TL influences IWB through three clusters of psychological mechanisms (e.g., motivational, relational, and collaborative) using the MASEM approach.

Theoretical implications

Our findings contributed to existing literature by showing that social exchange theory (Blau 1964) and self-determination theory (Deci and Ryan 1985) are complementary and comprehensive frameworks for understanding the TL-IWB link. These theories jointly explain how TL stimulates three underlying psychological mechanisms (motivational, relational, and collaborative) that ultimately foster IWB. Further, we determined that the effectiveness of TL in fostering IWB varies with the suppressive effects of contextual variables, such as national culture (e.g., the power distance-collectivism configuration and uncertainty avoidance).

First, the overall effect size of the TL-IWB relationship was positive and large, consistent with our theoretical predictions. As previously discussed, TL causes employees to prioritize the organization's goals over their own by empowering them (Parry & Proctor-Thomson, 2002; Seltzer et al., 1989). A sense of self-belief, confidence, and an alluring vision of the future is also fostered in followers by

transformational leaders, thereby increasing the use of novel and independent methods of completing work (Bass and Avolio 1990). Given that IWB are creativity- and innovation-oriented behaviors that are out of the ordinary, employees with a perception of TL will be more self-confident and more likely to challenge the current status quo. Consequently, such employees are more likely to engage in IWB, which are by nature oriented toward creativity and innovation (Ekaningsih 2014; Jung et al. 2003; Scott and Bruce 1994). These findings are also consistent with the social exchange theory (Blau 1964), social cognitive theory (Bandura 1986), leader-member exchange (LMX) (Dansereau et al., 1975; (Graen 1987; Graen and Uhl-Bien 1995), and self-determination theory (Deci and Ryan 1985) theories, which are widely used by primary research to explain the TL-IWB relationship. For example, transformational leaders' knowledge sharing (Bednall et al., 2018; (Saif et al. 2024) with employees and the quality of interpersonal relationships (e.g., LMX) they establish encourage work engagement (Aryee et al. 2012; Liu et al. 2019) and trust (Li et al. 2019), paving the way for IWB. In other words, in line with social exchange theory, transformational leaders foster high-quality leader–member exchange relationships characterized by trust, reciprocity, and mutual support. These high-quality exchanges encourage knowledge sharing, work engagement, and cooperation, thereby creating favorable conditions for innovative workplace behavior (IWB). In addition, social cognitive theory (SCT) and self-determination theory (SDT) offer complementary perspectives by highlighting how personal agency (via SCT) and intrinsic motivation (via SDT) jointly foster IWB as a response to TL. According to social cognitive theory, leaders may act as exemplars by showcasing innovative work behaviors that workers can replicate (Bandura 1986). Accordingly, transformational leaders may foster a culture of experimentation by modeling behaviors such as risk-taking, motivation to learn, and problem-solving behaviors (Afsar and Umrani 2020; Bass and Riggio 2006; García-Granero et al. 2015).

Moderation analysis revealed that the overall effect size of the TL-IWB relationship was significantly stronger in studies conducted in vertical-collectivist and high-uncertainty-avoidance cultures. This finding indicates that the effectiveness of TL is not universal but context dependent. In other words, the leader's effectiveness is shaped by the cultural context in which followers interpret the signals the leader sends.

The results show that one significant moderator identified in this study is cultural configuration. Specifically, the overall effect size of the TL-IWB relationship is stronger in vertical collectivist (e.g., Eastern) cultures than in horizontal individualistic (e.g., Western) cultures. The varying cultural expectations regarding leadership and social obligations may help explain this result. In both vertical collectivist and horizontal individualistic cultures, members are attentive to how leaders treat them. However, in collectivistic cultures in particular, members' reactions are more likely to be affected by collective interests and role-based obligations (Rockstuhl et al. 2012). In such contexts, TL's emphasis on shared purpose and collective harmony in its relations with followers increases the followers' compliance with the leader's expectations and strengthens the leader's influence in defining and internalizing the set goals. In vertical-collectivistic cultures, where power distance and collectivism are high, individuals prioritize the community's interests and show deference to authority (Shavitt et al. 2006). In other words, in these contexts, TL resonates more deeply, as employees tend to align their personal goals with collective interests. Although prior research has suggested that leader effectiveness in promoting positive outcomes is higher in horizontal individualistic cultures than in vertical collectivist cultures (Rockstuhl et al. 2012), contradictory findings exist. These different results demonstrate that cultural characteristics do not operate in the same way for everyone. Rather, these characteristics or dynamics shape leaders' messages in different ways.

Studies also pointed out the nuanced effects of culture on IWB and creativity. For instance, (Yao et al. 2012) found that although horizontal and vertical individualism positively affect idea generation, only vertical collectivism positively affects idea implementation. Similarly, (Zhang et al. 2022) found that employees with a high vertical collectivist orientation are more creative than those with a high horizontal collectivist. Likewise, (Goncalo and Stew 2006) demonstrated that collectivistic individuals were less creative than individualistic individuals when explicitly instructed to be creative. However, when the promotion of creativity was explicitly aligned with the organization's collective social norms, collectivist individuals displayed higher creativity. As these explanations show, the alignment between cultural expectations and leadership messages plays a pivotal role in shaping and promoting IWB. When the information explained above is evaluated together, it can be said that these studies argue that innovation occurs when leader expectations are compatible with cultural norms regarding contribution, responsibility, and creativity.

Another cultural dimension moderating the TL-IWB link is uncertainty avoidance. Our results indicate that the TL-IWB relationship is stronger in cultures with high uncertainty avoidance. Although previous studies have found that high uncertainty avoidance hinders innovative work behaviors (Fischer et al. 2019; Goncalo and Stew 2006), in the case of TL, there are also studies arguing that IWB may be higher in cultures where uncertainty avoidance is high (Taras et al. 2010; Watts et al. 2020; Wei and He 2022). In

cultures with high uncertainty avoidance, employees tend to exhibit behaviors aimed at protecting their comfort zones, within boundaries drawn for them, by refraining from taking risks and motivated to avoid failure (Hofstede 2001). Nevertheless, a potential solution to this situation is trust in the leader and the psychological safety created by the transformational leader for employees (Carmeli et al. 2014; Moin et al. 2021; Yin et al. 2020). By reducing uncertainty through well-known characteristics of TL, such as vision, support, and reassurance, TL provides a cognitive frame that allows employees to reconsider uncertainty as manageable rather than threatening. In other words, transformational leaders can encourage employees to develop new, creative solutions and behaviors outside the box by creating a shared vision and supporting them (Avolio and Bass 1995; Khalili 2016). This idea is consistent with studies suggesting that certain leadership types minimize the inhibitory effects of uncertainty avoidance on innovative behaviors (Afsar and Masood 2018; Watts et al. 2020). Therefore, when employees overcome their fear of uncertainty avoidance through psychological safety (Watts et al. 2020), the leader's effectiveness in IWB will increase. Thus, uncertainty avoidance may even enhance the positive effect of TL on IWB rather than suppress it. Taken together, these insights indicate that culture is not a uniform contextual factor but a multi-layered system that shapes how leadership signals are interpreted. Rather than searching for a universally 'best' cultural profile for IWB or TL, the key lies in the degree of alignment between leaders' signals and followers' normative expectations within a given cultural setting. As these explanations indicate, the presence of such a cultural fit may amplify the influence of TL on IWB.

Beyond identifying when TL is effective across cultural contexts, it is also essential to explain *how*TL translates into innovative work behaviors. This requires unpacking the psychological mechanisms through which TL exerts its influence. In this respect, drawing on SET (Blau 1964) and SDT (Deci and Ryan 1985) theories, we conceptualized three clusters of mediating mechanisms namely motivational (e.g., psychological empowerment, work engagement, and intrinsic motivation), relational (e.g., trust in leader and leader–member exchange), and collaborative (e.g., psychological safety and knowledge sharing). Some of these mediators have been studied in primary research (e.g., intrinsic motivation and psychological empowerment (Koh et al. 2019), whereas others are synthesized meta-analytically for the first time in this study (e.g., work engagement, leader-member exchange, trust in leader, knowledge sharing, and psychological safety).

Considering the above explanations, we first examined the mediating effect of psychological empowerment, a motivational psychological mechanism in the TL-IWB relationship within the context of SET (Blau 1964) and SDT (Deci and Ryan 1985) theories. As discussed earlier, the visionary, supportive, and intellectually stimulating environment of TL shapes employees' cognitive appraisals and nourishes their self-efficacy perceptions. These findings are consistent with the assumptions of SET and SDT, indicating a partial mediating effect. TLs play a critical role in encouraging employees to exhibit IWB by empowering them through role modeling, verbal persuasion, and mastery experiences (Stanescu et al. 2021). One could easily predict that these effects may shape self-belief or self-perception, causing employees to see themselves as competent at generating novel solutions to challenges and problems. In other words, such self-beliefs, which are central to SDT, empower individuals to take proactive, autonomous actions, thereby enhancing IWB (Yalçınyiğit and Karaçay 2025; Yuan et al. 2022).

TLs also make their followers' environments more supportive. These environments could encourage work engagement, the second examined motivational psychological mechanism, which exhibited a partial mediating effect. Enhanced work engagement rewards individuals to allocate their discretionary effort towards their responsibilities, including participation in IWB (Aryee et al. 2012; Li et al. 2019; Schaufeli et al. 2002). Thus, work engagement could serve as a motivational pathway linking TL to IWB (Bakker et al. 2008; Zhang et al. 2018).

Findings also showed that intrinsic motivation partially mediates the relationship between TL and IWB. This finding is consistent with Self-Determination Theory (Deci and Ryan 1985). From this standpoint, fulfilling essential psychological needs (such as autonomy, competence, and relatedness) compels employees to regard their work as meaningful, thereby enhancing intrinsic motivation (Kovjanic et al. 2012). Ultimately, increased intrinsic motivation enhances individuals' propensity to exert additional effort in their tasks, encompassing participation in IWB (Alshahrani 2025; Hon 2012; Tierney et al. 1999; Xu et al. 2023). These motivational pathways collectively demonstrate how TL stimulates the cognitive and psychological factors that make innovative action both viable and appealing.

Unlike motivational mechanisms, which explain *why* employees feel capable and energized to innovate, relational mechanisms clarify *how*social exchange dynamics shape the willingness to take interpersonal and organizational risks. Thus, a second cluster of mechanisms involves relational pathways, namely, leader-member exchange (LMX) and trust in the leader. Within the framework of SET (Blau 1964), LMX and trust in the leader were examined as mediators of the relationship between TL and IWB. The results indicated that trust in the leader fully mediated the link between TL and IWB. In other words, in the absence of

a trust-based relationship, TL behaviors alone may be inadequate to stimulate IWB. According to the SET (Blau 1964) theory, a sense of trust built on mutual quality relationships and support can encourage employees to go beyond their limits and role definitions, leading them to exhibit IWB. Transformational leaders' high-quality relationships with employees, open dialogue, individualized support, intellectual stimulation, and commitment to employees' well-being demonstrate concern and respect for them (Sharifirad 2013). Employees with such positive perceptions are more likely to develop positive attitudes and emotions in response, thereby increasing their trust in leaders. As a result, employees perceive less interpersonal risk, feel more psychologically safe, and are more likely to challenge the status quo by expressing original thoughts, ideas, and behaviors, thus demonstrating IWB.

LMX, in turn, captures the ongoing exchange relationship between leaders and followers (Schermuly et al. 2013). The findings showed that LMX partially mediates the relationship between TL and IWB. In other words, while trust serves as a core relational gateway, high-quality LMX reinforces feelings of being valued and supported. The resulting strong LMX relationships lead employees to feel more valued, take responsibility, and exhibit IWB (Bass and Avolio 1990; Schermuly et al. 2013). Taken together, we may conclude that relational mechanisms operate in complementary ways: trust, by reducing relational risk, and LMX, by strengthening mutual obligation, all together demonstrate how TL may increase IWB.

Finally, we examined the collaborative psychological mechanisms. Psychological safety and knowledge sharing are analyzed as mediators of the relationship between TL and IWB within the framework of SET (Blau 1964).

The findings showed that psychological safety partially mediates the relationship between TL and IWB. (Newman et al. 2017) conducted a comprehensive meta-analysis demonstrating that psychological safety serves as a critical mediating variable in the leadership-innovation relationship by lowering the fear of failure and promoting risk-taking (Newman et al. 2017). Leadership behaviors that improve psychological safety create positive, meaningful experiences that motivate employees to try innovative and creative activities.

SET also states that when leaders are open and encouraging, employees are more likely to exchange knowledge with each other, which leads to IWB (Wang and Noe 2010). Our findings also showed that knowledge sharing partially mediates the relationship between TL and IWB. (Dong et al. 2017) conducted a meta-analysis of the relationship between leadership and knowledge sharing, finding that transformational leadership (TL) significantly influenced knowledge-sharing behaviors, thereby impacting innovative behavior.

The discovery of partial mediation for both psychological safety and knowledge sharing suggests that TL affects IWB through various channels (Hayes 2018). This aligns with various viewpoints on innovation through collaborative effort, which contend that innovation outcomes emerge from numerous interacting mechanisms rather than a single causal pathway. (Choi et al. 2016) empirically demonstrated this synergistic effect, indicating that the interaction between psychological safety and knowledge sharing yielded significantly enhanced innovation outcomes.

When all findings are evaluated in the context of relevant theories, it can be argued that the TL-IWB relationship is neither linear nor universally stable; in other words, it results from multiple interconnected factors. TL shapes followers' innovative behavior through distinct yet complementary psychological mechanisms. So, the strength and effectiveness of these mechanisms depend on how followers understand leadership signals in their own culture. In this context, by integrating the motivational, relational, and collaborative psychological mechanisms conceptualized in this study with cultural boundary conditions, this study goes beyond the traditional generalization that "TL enhances innovation" and offers a multilayered perspective on why TL works and when its effects intensify or wane. This integrated perspective not only sharpens the conceptual boundaries of TL-IWB research but also provides a more consistent and robust foundation for future theory development.

Practical implications

The results of our study are very important for managers and policymakers. First, it has been demonstrated that TL, which correlates with a variety of positive variables (e.g., performance, job satisfaction, work engagement, organizational commitment), plays a crucial role in fostering IWB (Gui et al. 2020; Sethibe and Steyn 2017). Recent studies (Yildiz et al. 2017) indicated that numerous individual and organizational factors can increase IWB (e.g., proactive personality, perceived organizational support, and psychological empowerment). Similarly, studies indicate that TL skills can be developed (Bass and Avolio 1990). It may be argued that training courses that simultaneously strengthen and expand these two strongly associated variables can be highly advantageous.

Organizations should recruit transformational leaders because these leaders possess effective leadership skills to increase innovative work behaviors and to reveal the potential of employees capable of exhibiting behaviors that enhance performance and add value at the individual, group, and organizational levels, e.g., IWB. Managers may also establish mentoring initiatives that enable workers to observe and acquire IWB in real time, consistent with the

notion of learning through observation in social cognitive theory (Wood and Bandura 1989). Further, by promoting group- or team-oriented problem-solving endeavors (Griffin and Guez 2014; Nguyen et al. 2024), participative decision-making (Black and Gregersen 1997; Bouwmans et al. 2017), and employee empowerment (Alzoubi and Alzoubi 2023; Monica and Krishnaveni 2019), managers may implement the reciprocity mechanisms of SET, whereby workers feel appreciated and respond with innovative solutions, e.g., IWB.

Furthermore, acknowledging the moderating influence of cultural configurations, such as vertical collectivism, and aspects such as uncertainty avoidance, businesses need to adapt leadership methods to their operational cultural setting. For example, it is known that in societies with high uncertainty avoidance, employees prefer openness, avoid risk, and reject ambiguity. Therefore, transformational leaders can increase their effectiveness in these contexts by using visionary behaviors, open communication with followers, and risk-minimizing strategies to create the perception among employees that innovative behaviors and ideas are risk-free. Consequently, organizations operating in contexts with high uncertainty avoidance can enhance their effectiveness and increase IWB by equipping leaders with various skills, such as individualized consideration, inspirational motivation, and vision. In addition, leadership development programs that support innovative thinking and behaviors that reduce uncertainty should be established through mechanisms such as psychological safety, trust in the leader, knowledge sharing, psychological empowerment, and the development of high-quality relationships with employees. Furthermore, in contexts with a high uncertainty avoidance culture, managers can encourage trust, and thus IWB, by engaging employees in low-risk pilot projects and various practices to foster risk-taking and, in turn, IWB. So, it can be said that workers in these kinds of places are more likely to engage in innovative and creative work because they feel safe. On the other hand, in the opposite context (cultures with low uncertainty avoidance), leaders can encourage IWB by emphasizing mechanisms such as autonomy, exploration, and informal and rapid feedback to encourage IWB. Consequently, leadership development needs to embrace a culturally responsive, situational methodology that harmonizes leadership approaches with existing cultural norms regarding risk, structure, and tolerance for innovation. This culturally sensitive model optimizes TL's efficacy in fostering IWB across diverse global contexts, rather than relying on a single approach.

Limitations and future directions

Despite having a solid analytic and theoretical framework, the present study has some limitations. First, although most researchers used SDT and SET separately to explain the linear relationship between TL and IWB, future researchers may investigate their combination to understand how TL promotes IWB across a variety of cultural or organizational contexts (House 2004).

Second, culture was identified as a statistically significant moderator that explained the high heterogeneity in the overall effect size. Given the small amount of variance explained by the moderator (e.g., culture), this study did not cover other important moderators. Therefore, it is believed that this study, which will serve as a road map for future research, will provide a foundation for identifying other potential moderators such as sector, presence of social desirability bias assessment, firm size (Yuan et al. 2022), time (Gui et al. 2020), and organizational tenure (Liu et al. 2016).

Thirdly, when considering that most of the included studies are cross-sectional, the possibility of reverse and reciprocal causation must be considered. To obtain more robust results, it is recommended that future studies include only longitudinal studies or a combination consisting of an equivalent number of cross-sectional and longitudinal studies. Similarly, most of the studies whose rating source is self-reported and the fact that various biases (e.g., social desirability bias) are moderators. Therefore, these unspecified factors should be considered as potential moderator variables by future research.

Fourth, because innovation is a multi-stage process that typically begins with creativity and progresses toward implementation, this study deliberately focuses on the implementation phase, namely, IWB. Therefore, future researchers are encouraged to focus on the relationship between the different stages of innovation and TL and to comparatively demonstrate the effectiveness of TL across these stages. Such work may clarify whether TL exerts differential effects on creativity, idea promotion, and idea implementation.

Also, although cultural moderation was examined through subgroup analyses, this approach doesn't account for how different cultural aspects might be related (e.g., cultural configuration and uncertainty avoidance). Future meta-analytic studies with more primary studies may use multivariate meta-regression to model multiple cultural dimensions simultaneously.

Lastly, to better understand the causal mechanisms, future research could test the roles of other mediators not included in this study because of the scarcity of primary studies (e.g., organizational support, psychological ownership, organizational commitment).

Conclusion

This study presents one of the most comprehensive systematic reviews to date on the specific impact of TL on IWB. Drawing on SET and SDT, we examined when and how TL fosters IWB by jointly analyzing its relationships with specific moderators and mediators using the MASEM approach. The findings suggest that TLs are pivotal actors in fostering IWB; however, the effectiveness of TL is contingent on several contextual factors (cultural configuration and uncertainty avoidance) and underlying psychological mechanisms (e.g., motivational, relational, and collaborative).

The study contributes to existing literature in several significant ways. First, it consolidates and maps the structure of cumulative knowledge on the TL-IWB relationship, clarifying mixed results and highlighting the conditions under which TL exerts a stronger or weaker influence. Another significant contribution is that, using MASEM analysis, we demonstrate three previously underexplored psychological pathways, showing that motivational (e.g., psychological empowerment, work engagement, intrinsic motivation), relational (e.g., leader–member exchange, trust in leader), and collaborative (e.g., psychological safety, knowledge sharing) mechanisms jointly explain how TL translates into innovative behavior. This study is important because it reveals the collective influence of moderators and mediators on the TL-IWB relationship and synthesizes findings from individual studies to clarify its nature. Thus, it demonstrates that the TL-IWB relationship is complex, context-specific, and indirect, rather than direct and uniform as reported by primary studies.

Given the findings, the information obtained is important for policymakers, decision-makers, and leaders in understanding how and under what conditions TL leads to IWB or enhances its effectiveness. In this context, understanding the mediating mechanisms through which TL operates and, in turn, affects IWB underscores the importance of fostering a process-oriented, person-centered relationship with employees. On the other hand, moderator analyses are crucial for clarifying the cultural contexts in which these relationships work most effectively. This meta-analysis clarifies the mechanisms by which and when TL fosters IWB. Additionally, it sets the stage for future research to investigate the impact of TL across various stages of the innovation process and to examine the cultural boundaries identified in this study.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s12144-026-09567-8.

Funding Open access funding provided by the Scientific and Technological Research Council of Türkiye (TÜBİTAK).

Declarations

This study is based on the PhD thesis of Elif Şanlıöz, prepared under the supervision of Prof. Dr. Bora Yildiz at Istanbul University.

Competing interests The authors have no competing interests to declare that are relevant to the content of this article.

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